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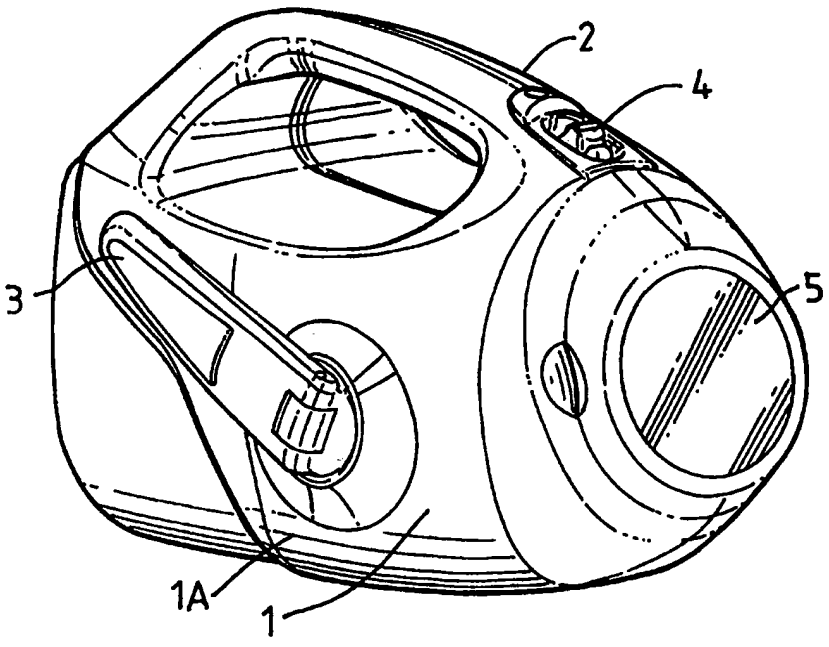

(57) Abstract

The invention concerns an electric generator comprising a source of mechanical power, a generator driven by said source of mechanical power so as to provide electrical current for a load; also included may be a circuit for providing a variable duty cycle to the load or means for mounting a battery whereby in operation a mounted battery acts to buffer excess current generated by said generator, the battery being adapted to release current to a load when the generator starts to deliver less current than a predetermined value.

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ELECTRIC GENERATOR

The present invention concerns electricity generators and is particularly, though not exclusively, concerned with the generation of power for torches using energy stored in a spring. However it is also applicable to other equipment requiring electric power such as radio receivers, computers and playstations.

Important factors which have to be taken into account are the design of the spring engine, the transmission, and the control circuitry so that these have the minimum weight and size and can provide power for the longest possible period.

In accordance with the present invention there is provided an electric generator comprising a source of mechanical power, a generator driven by said source of mechanical power so as to provide electrical current for a load and means for mounting a battery whereby in operation a mounted battery acts to buffer current generated by said generator which is in excess of the requirements of the load.

In order that the present invention may be more readily understood an embodiment thereof will now be described by way of example and with reference to the accompanying drawings, in which

Figure 1 is a perspective view of a torch;

Figure 2 is a perspective view from the rear of the torch of Figure 1;

Figure 3 is a view showing details of the torch wit its lamp cover removed;

Figure 4 is a view of a second embodiment showing how the lamp portion of the torch can be used separately from the main body of the torch;

Figures 5A and 5B are perspective views of an assembly for providing electrical energy which is mounted within the main body of the torch of figures 1 to 4

Figures 6 and 7 illustrate diagrammatically the spring motor of the assembly of Figures 5A and 5B;

Figures 8 and 9 are perspective views showing alternative forms of the gear train;

Figures 10A and 10B shows a dog clutch;

Figures 11 and 12 are circuit diagrams of different embodiments of control circuitry; and

Figure 13 is an exploded view of the torch of Figure 1;

Referring now to Figure 1 of the accompanying drawings this figure shows a torch having a main body 1 moulded from a thermoplastics material and incorporating an electrical generator in accordance with the present invention. The main body 1 has an integral handle 2 and one side thereof is provided with a fold away winding handle 3 by means of which a spring power arrangement mounted in the main body can be wound up. The torch is provided with a switch 4 which controls its functions. A lens assembly 5 is shown at the front of the torch. A 12 VDC input socket 5 and a 3V DC output socket 7 are provided at the rear of the main body of the torch.

Figure 4 shows an alternative embodiment of the torch in which a front portion including the lens assembly 5, can be removed for independent use.

The main body 1 in both embodiments is made from moulded halves 1a, 1b are suitably fastened together. In the present embodiment the two halves are screwed together and trap a member 1C which is of rubber.

Figure 3 of the drawings shows the torch bulb 9, a rechargeable battery 10 and a spare bulb 11.

In the embodiment of Figure 4 a pivoted portion acts as a handle 8 for a user when the lamp portion has been detached from the main body, the main body 1 having a corresponding recess 8' into which the handle 8 fits when the two units are locked together.

This detachable assembly is positively seated into the main unit and in this position the main switch engages with a mechanical brake which will be described hereinafter. Contacts on both the main assembly and detachable assembly allow for both charging the battery and operation of the bulb by the spring generator mechanism in the attached position.

Referring now to Figures 5A and 5B of the drawings these show a spring power unit which comprises a pair of bobbins mounted in a chassis 22. One bobbin is a torque bobbin onto which a coil spring can be wound and the other in a storage bobbin onto which a spring can unwind. This arrangement can be seen more clearly in Figure 6 where the storage bobbin is shown at 14 and the torque bobbin is shown at 15. The torque bobbin 15 provides its output via a torque shaft 16.

The storage bobbin 14 is freely rotatable about a shaft 17 and a pretensioned steel band spring 18 has one end fixed to the storage bobbin and its other end fixed

to the torque bobbin. In operation the torque bobbin 15 is wound up by the winding lever 3 shown in Figures 1 and 2 in the direction of arrow A and the spring 18 is wound from the storage drum onto the torque bobbin. By this means the spring 18 is stressed to store mechanical energy which can subsequently be delivered via the torque shaft 16. The energy stored in the spring and the torque subsequently delivered is dependent upon the spacing between the axes of the two bobbins 14 and 15, which axes are arranged to be substantially parallel. The energy also depends upon the relative diameters of the two bobbins and upon the width and thickness of the material of the spring 18.

Associated with this spring is a gear train generally indicated at 19 for driving a DC generator 20 in response to the unwinding of the spring 18. This gear train in the present embodiment has a ratio of 254:1 but of course this can be varied.

Figure 7 of the drawings which shows in diagrammatic form the storage drum 14, torque drum 15, gear train 19, DC generator 20, power control circuit 21, and the bulb 9.

In the actual embodiment the spring power unit includes a chassis 22 carrying the various components and

a plate 23 which retains the output gear train 19 details of which train will be described hereinafter.

Referring now to Figures 8 and 9 of the drawings of the drawings, these show alternative embodiments of the gear train which is driven by the spring and bobbin system just described.

Referring now to Figure 8 this shows a gear train in which the output of torque shaft 16 is supplied via a splined shaft 30 to a first gear wheel 31 having a toothed outer periphery 32 engaging a drive pinion 33 on a second toothed gear wheel 34, the gear wheel 34 driving a similar, hidden pinion on a third gear wheel 35 which in turn drives an output pinion 36 connected to the generator 20.

In the embodiment of figure 9 the arrangement of the gear wheels is the same but the output of final gear wheel 35 is taken via a belt 37 to a pulley 36. This arrangement is less efficient than a totally toothed gear train but is quieter in operation. In both of the variants of the gear train a relatively soft material such as Desmopan (RTM) is used at some or all of the three gear interfaces. The compound gears themselves are made from a harder material such as Acetyl (RTM).

In order for the torch being described to provide instantaneous light after a period of storage the spring mechanism just described needs to be retained at least partially wound.

Referring again to Figures 5A and 5B of the drawings it will be seen that this is achieved by a mechanical brake 40 pivotally mounted at 41 to one corner of the chassis. The brake comprises a pair of arms 42, 43 with arm 42 in the braking state resting on the outer rim of the final gear wheel. Because of the very high gear ratio of the gear train even a very powerful spring can be prevented from unwinding by a minor obstruction of the output gear train movement by the mechanical brake. Release of the final gear wheel can carried out by the off-on 4 switch shown in Figure 1 so that the arm 42 is moved away from contact with the final gear wheel.

Figures 10A and 10B of the drawings show the mechanism by means of which the winding handle 3 drives the torque pulley 15. As can be see the handle is pivotally mounted to a post 44 by a spindle 45 and carries one side of a toothed dog clutch mechanism 46 the other side of which is integral with torque bobbin 15. A compression spring 47 biases the dog clutch into engagement to ensure that during winding the toothed faces of the dog clutch mechanism engage satisfactorily.

Engagement of the clutch occurs when the handle 3 is lifted from its stored position and pivoted 180° into the winding position so that a camming action allows the dog clutch to move into engagement.

Reference will now be made to Figure 11 of the accompany drawings which discloses control circuitry which can be used in the torch shown in Figures 1 to 4. The torch bulb requires a constant power input. If the spring generator were unregulated it would provide a varying power output due to the diminishing input torque from the torque bobbin 15 as the spring unwinds.

An embodiment of the an electronic regulator circuit is shown in Figure 11. This circuit imposes a variable duty cycle on the spring/generator arrangement in which the unwind rate of the spring is relatively low when the spring torque input is high and is relatively high when the spring torque input is low. The inverse variance of torque and speed combine to provide a constant electrical power delivery.

Another version of the power control circuit is shown in Figure 12. In this version the bulb and generator are interfaced with a rechargeable or primary battery. This is the battery 10 shown in Figure 3. In a practical embodiment battery 10 can be provided by two

series connected 1.5V rechargeable batteries. In the main mode of operation of the torch the battery 10 has the effect of absorbing power generated in excess of the power rating of the bulb and storing this excess power for use when the generated power drops below the bulb rating. In this way the presence of the battery acts as a buffer so that the bulb will see a substantially constant current in operation of the torch. Thus the circuit of Figure 12 by incorporating a battery provides the same advantage as the electronic regulator circuit of Figure 11 but with the added advantage that the battery can be used independently as for example in the embodiment of Figure 4 where the lens portion can be removed as a separate torch. As will be described hereinafter the battery 10 can also be charged by an external 12VDC power supply as well as by the spring arrangement.

In order to prevent reverse current flow from the battery 10 through the generator once the spring 18 has ceased to turn the generator circuit 12 includes three diodes 50, 51 and 52 connected in series with a resistor 53 between the outputs of the generator 20. The junction between the diode 52 and resistor 53 is connected to the base of a transistor 54 which in turn controls the operation of a transistor 55 in the output line 56 from generator 20. It is possible for the three diodes 50,

51, 52 to be replaced by a single Schottky diode.

Another feature of the circuits shown in Figure 12 is the provision of a low voltage cut out. Rechargeable batteries are exposed to potential damage either of fully discharged or discharged below a predetermined voltage. In order to prevent this, should the battery 10 be inadvertently left in circuit, a low voltage cut out circuit is provided which comprises two diodes 57, 58 and two resistors 59, 60 connected between the supply line 56 to the bulb 9 and ground. The diodes 57, 58 provide a voltage drop whilst the resistors 59, 60 determine at what voltage the battery will be isolated from the circuit in order to leave a safe margin above 0 volts. It is of course possible to replace this circuit with a mechanical switch.

The circuit shown in Figures 12 also includes a flasher unit which when selected interrupts power to the bulb 9 periodically. This flasher unit includes transistors 61 and 62 and a switch generally indicated at 63. The frequency of the flashing operation is set by capacitor 69. This circuit also acts as a secondary cut-off unit with the cut-off voltage set by the values of resistors 77 and 78.

It will be seen that switch 63 has four possible

switching conditions so that apart from the flashings/continuous states it has an "off" state and a "charge" state. These can be set by the main switch 4 shown in Figures 1 to 4.

When in the flashing state energy generated by the spring during the bulb interruption period is directed to the battery for later recovery so that the "flasher" shine time will exceed continuous bulb "on" time.

Another feature of the circuit of Figure 12 is that the battery may be charged via a mains adapter. An input for external charging for connection to a mains adaptor is shown at 70 and corresponds to socket 6 shown in Figure 2. The control circuit generally indicated at 71 includes a chip 72 which in operation counts to a predetermined number at a predetermined rate set by resistor 79 and capacitor 80. When the chip 72 reaches the predetermined number resistor 74 is switched out of circuit by transistor 72 leaving resistor 73, which is of a much higher value, still in circuit. This substantially lowers the charging current to the battery. During the initial charge period set by chip 72 a LED 76 lights up but turns off once only resistor 73 is still in circuit changing the charge current to the battery to a low trickle specified for the particular battery fitted. The values of the circuit components are set so

as to provide the appropriate charging currents.

The circuit of Figure 12 has been described mainly with respect to a rechargeable battery. However a primary battery will also function adequately as a buffer between the output of the generator and the bulb as a primary battery is capable of absorbing the relatively low charging current without damage.

It is also possible for the power generator to be used to drive another accessory via the output 71 and this corresponds to output socket 7 also shown in Figure 2.

It will thus be appreciated that the torch described herein has a number of capabilities which enable it not only to function satisfactorily as a torch but also to act as a power supply for other pieces of equipment.

The provision of a battery both extends the period over which the torch will shine or other equipment will operate. When used for a torch the life of the bulb will be increased by the bulb being buffered from varying supply currents.

The inclusion of the rechargeable battery also adds to its versatility since the torch can be used on a

regular basis by directly recharging the battery from the mains, whilst the spring will be able to power the torch in the event of the battery going flat or if there are no batteries available.

In the embodiment of Figure 4 where the lens system of the torch is detachable from the main body the torch functions as an ordinary battery powered torch with relatively compact dimensions.

Referring now to the exploded view shown in Figure 13 of the accompanying drawings this shows that the main body 1 is made in two halves 100 and 101 with the side 101 carrying the handle 2. As shown in Figure 13 handle 2 comprises a winder crank 103 carrying at one end a winder knob 104. The handle also comprises a cam washer 105 a handle pin 106 a coil spring 107 and a clutch spring washer 108. The dog clutch plates of the dog clutch already described are shown at 109 and 110 and the end cap of the torque bobbin is shown at 111. The torque bobbin itself is shown at 112 together with a ratchet 113 held by a bayonet bush 114. The spring storage bobbin is shown at 115 and a pin associated with the spring storage bobbin 115 is shown at 116.

The generator driven by the spring mechanism is shown at 117 and two alternatives for the gear train for

driving the generator are shown in the figure. The first gear train is all splined and comprises an input gear 118 a secondary gear 119 having a gear spline 120 and a final gear 121 driving a motor gear 122 mounted on a axial 123. In the alternative form the final gear 121 can be a pulley 121' driven by a belt 124 and in turn driving a motor pulley 122'. The gears are mounted on a gear plate 125 and held in place by a gear keeper 126 whilst a mechanical brake is shown at 127. A seal for the main body is shown at 128 and the main PCB is shown at 129 along with electrical switches 130, 131 the battery socket 132, a bulb socket 133 and a bulb 134.

An interconnect between the main body and the lens assembly is shown at 135, the battery at 136 a lens seal 137 and a lens front enclosure at 138. The lens assembly is finally completed by a metallised reflector 139 and a lens 140.

CLAIMS

1. An electric generator comprising a source of mechanical power, a generator driven by said source of mechanical power so as to provide electrical current for a load and means for mounting a battery whereby in operation a mounted battery acts to buffer current generated by said generator which is in excess of the requirements of the load.

2. A generator according to claim 1, wherein in operation the battery is adapted to release current when the generator starts to deliver less current than a predetermined value.

3. A generator according to claim 1 or claim 2 including means whereby the battery when mounted can be charged from an external source separate from the generator.

4. A generator according to claim 3 and including a timer circuit for controlling charging of the battery from the external source so that the battery is not overcharged during the charging operation.

5. A generator according to any one of claims 2 to 4 including means for switching off the supply of current

to the battery before the battery reaches a predetermined voltage.

6. A generator according to any one of the preceding claims wherein the mechanical power source comprises torsion spring wound on a pair of bobbins, and wherein the torch includes a handle whereby the spring can be wound.

7. A generator as claimed in any one of the preceding claims and including a mechanical brake for preventing operation of the mechanical power source.

8. A torch including a generator as claimed in any one of the preceding claims.

9. A torch as claimed in claim 8 and including means whereby the bulb can be made in operation of the torch to flash.

10. A torch according to either of claims 8 or 9, wherein the lens assembly of the torch is detachable from the main body of the torch, the lens assembly including means for mounting a battery whereby the lens assembly when detached can act as a torch.

11. A torch according to any one of claims 8 to 10 and

including an output socket whereby energy can be supplied to an external device.

12. An electric generator comprising a source of mechanical power, a generator driven by said source of mechanical power so as to provide electrical current for a load and a circuit for connecting said generator to a load so as to provide a variable duty cycle to the load so that the output to the load remains constant.

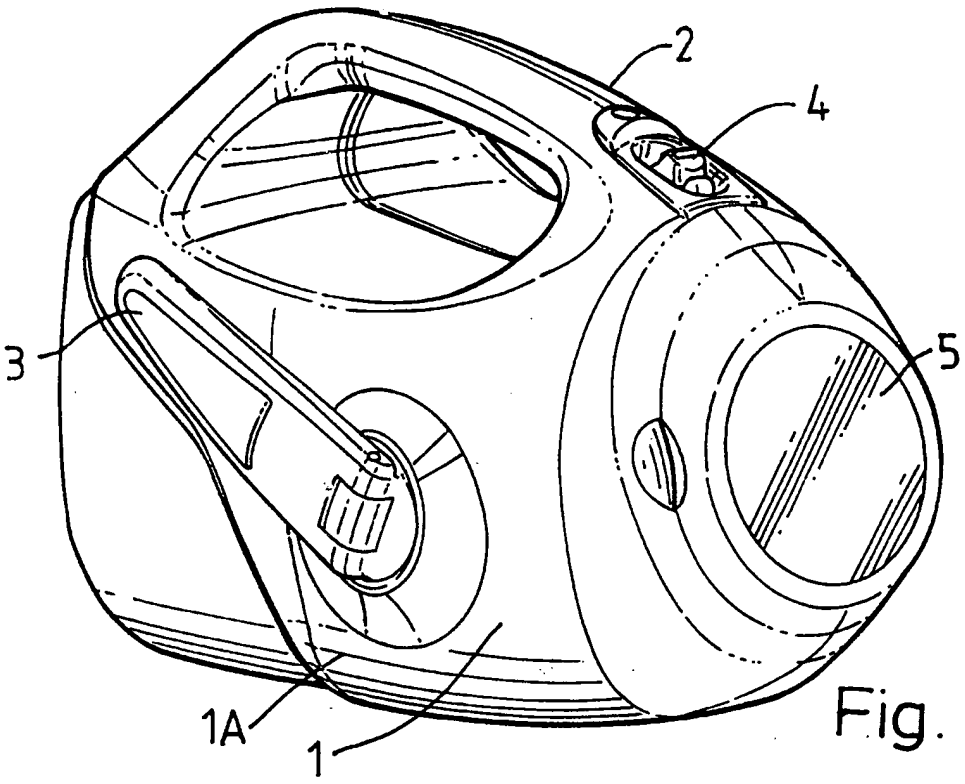


Fig. 1

Fig. 2

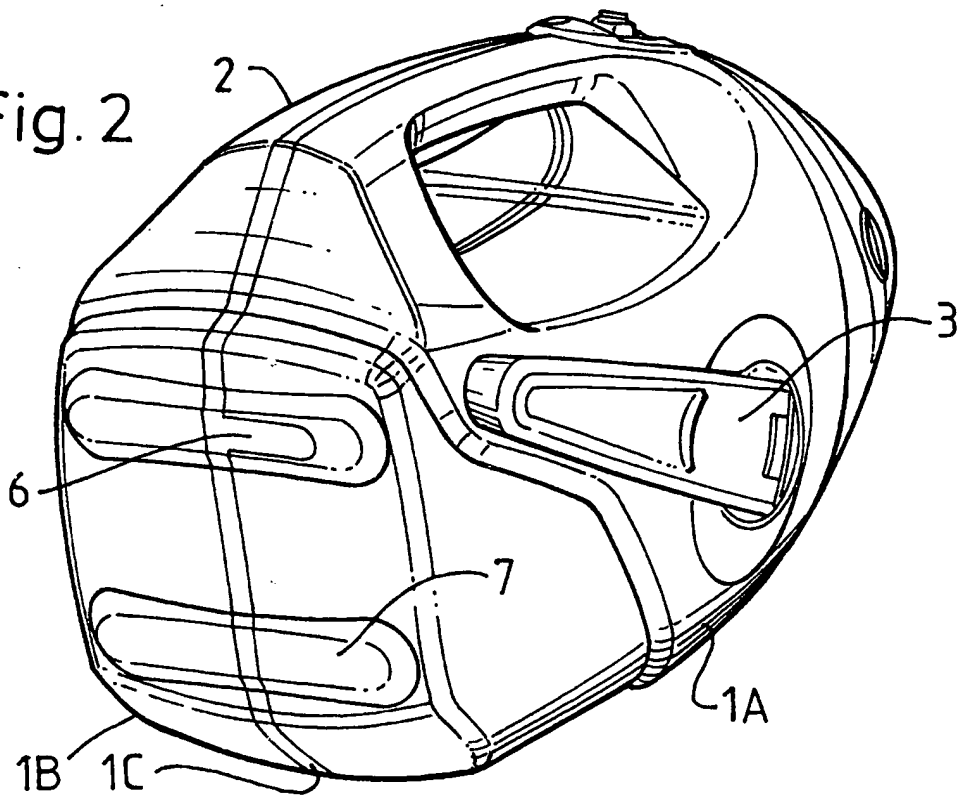
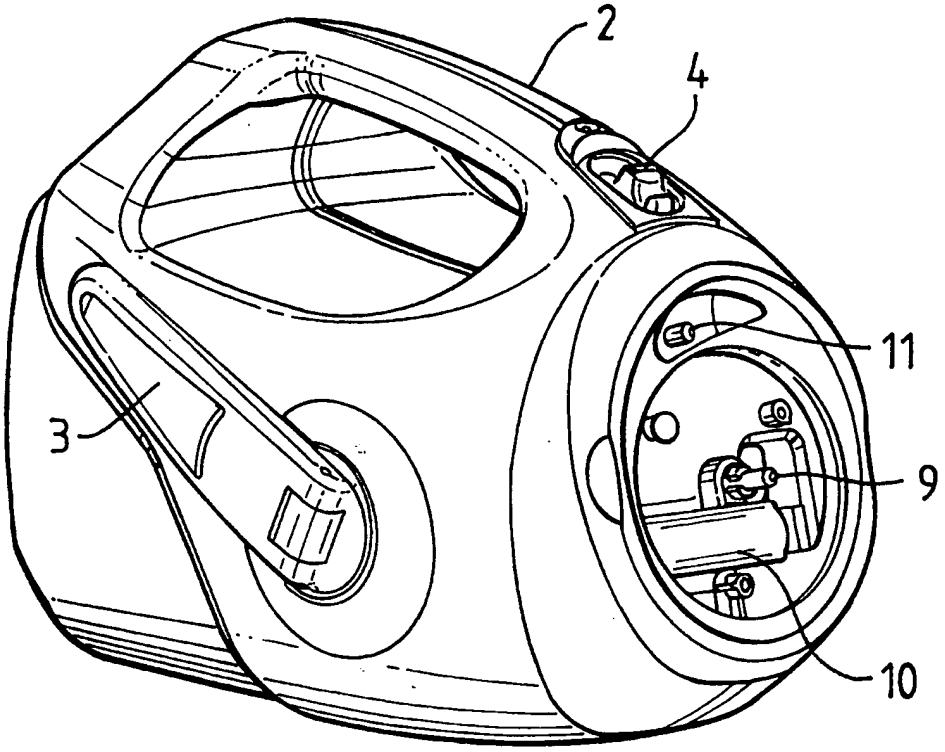


Fig. 3



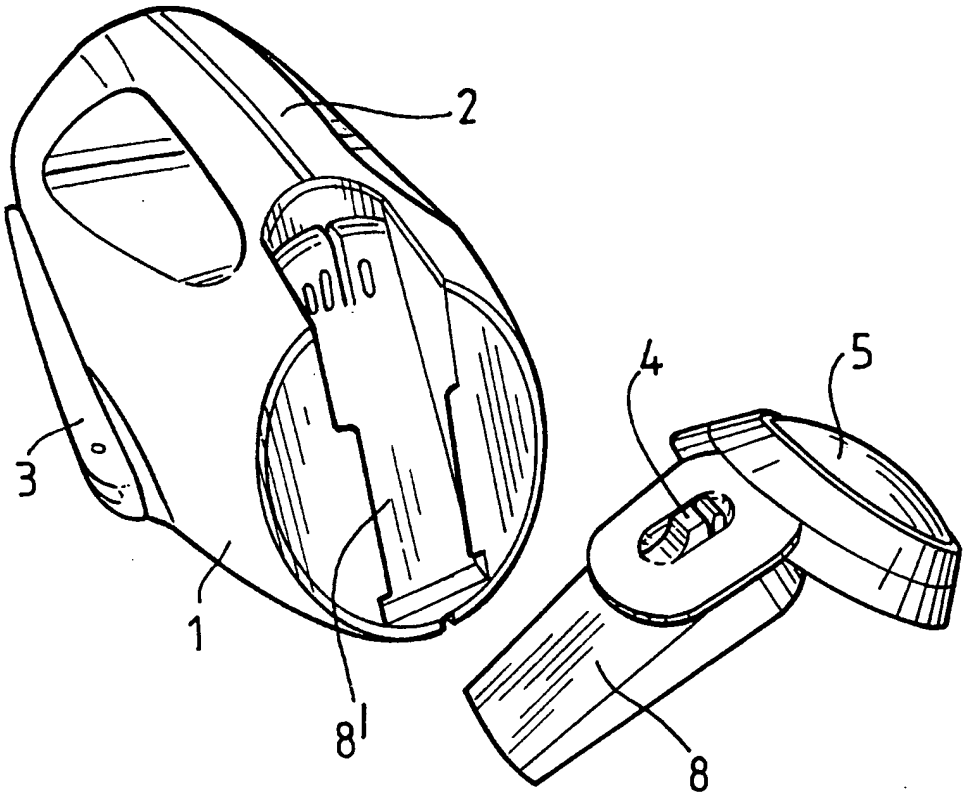


Fig. 4

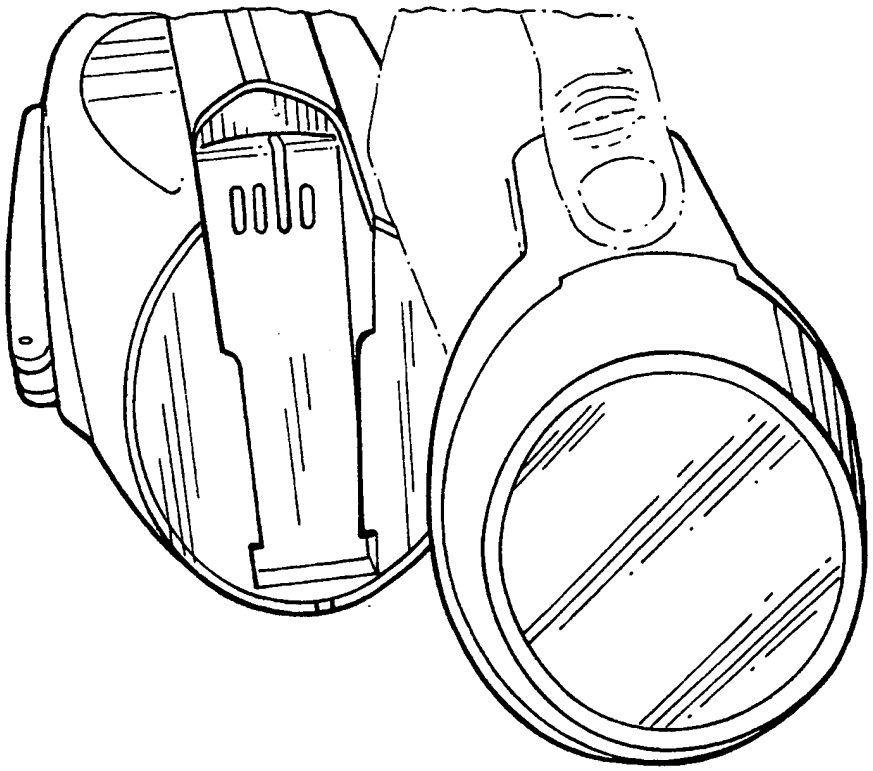


Fig.5A

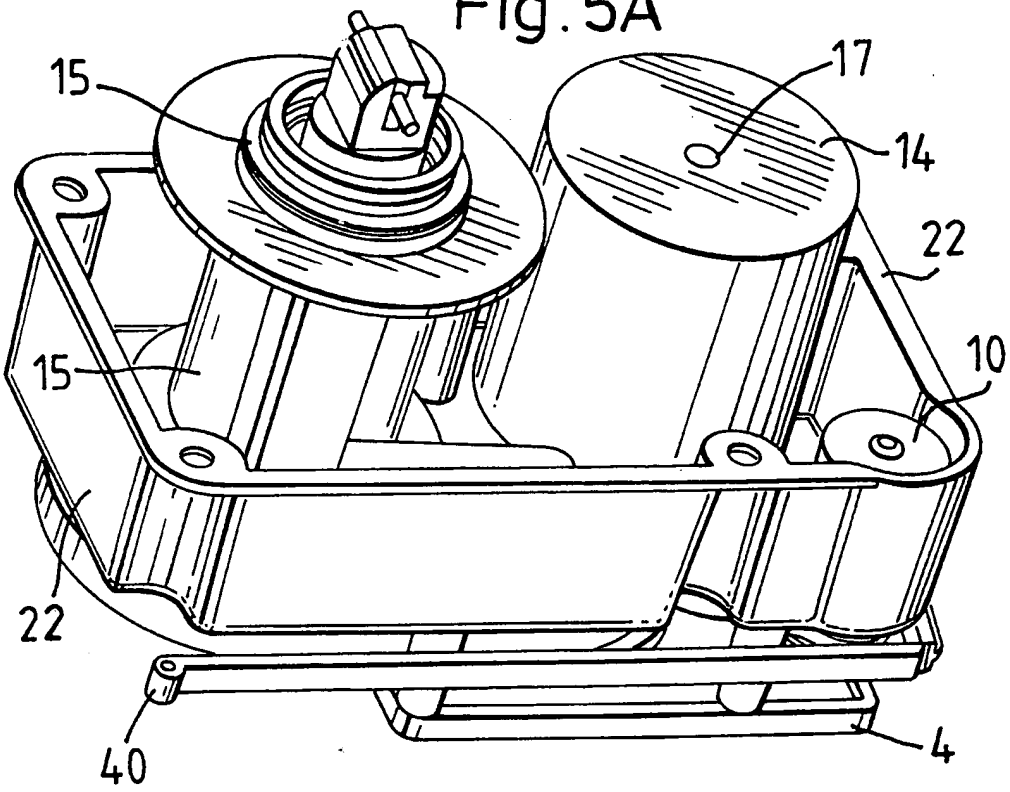
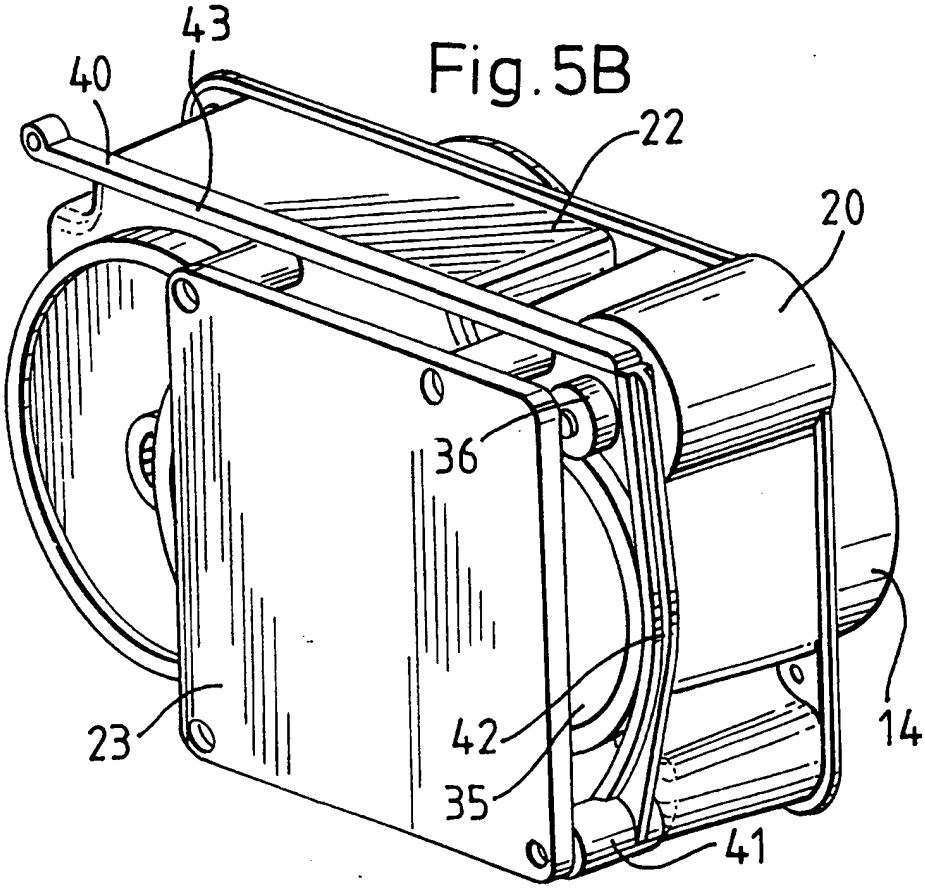


Fig.5B



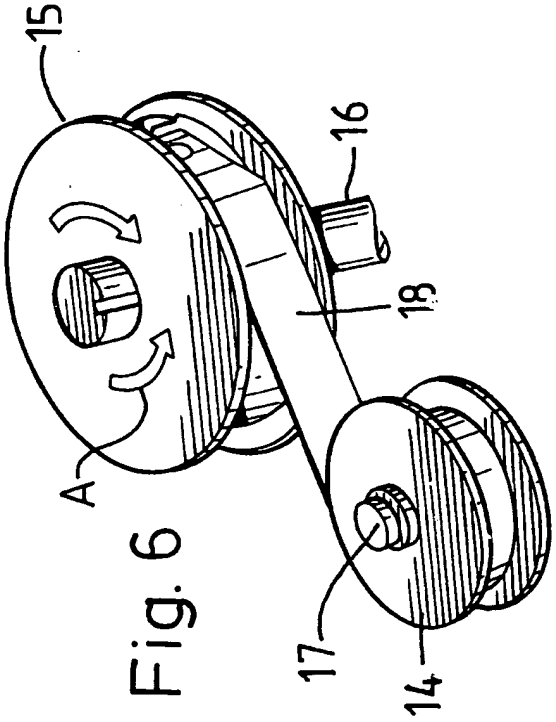


Fig. 6

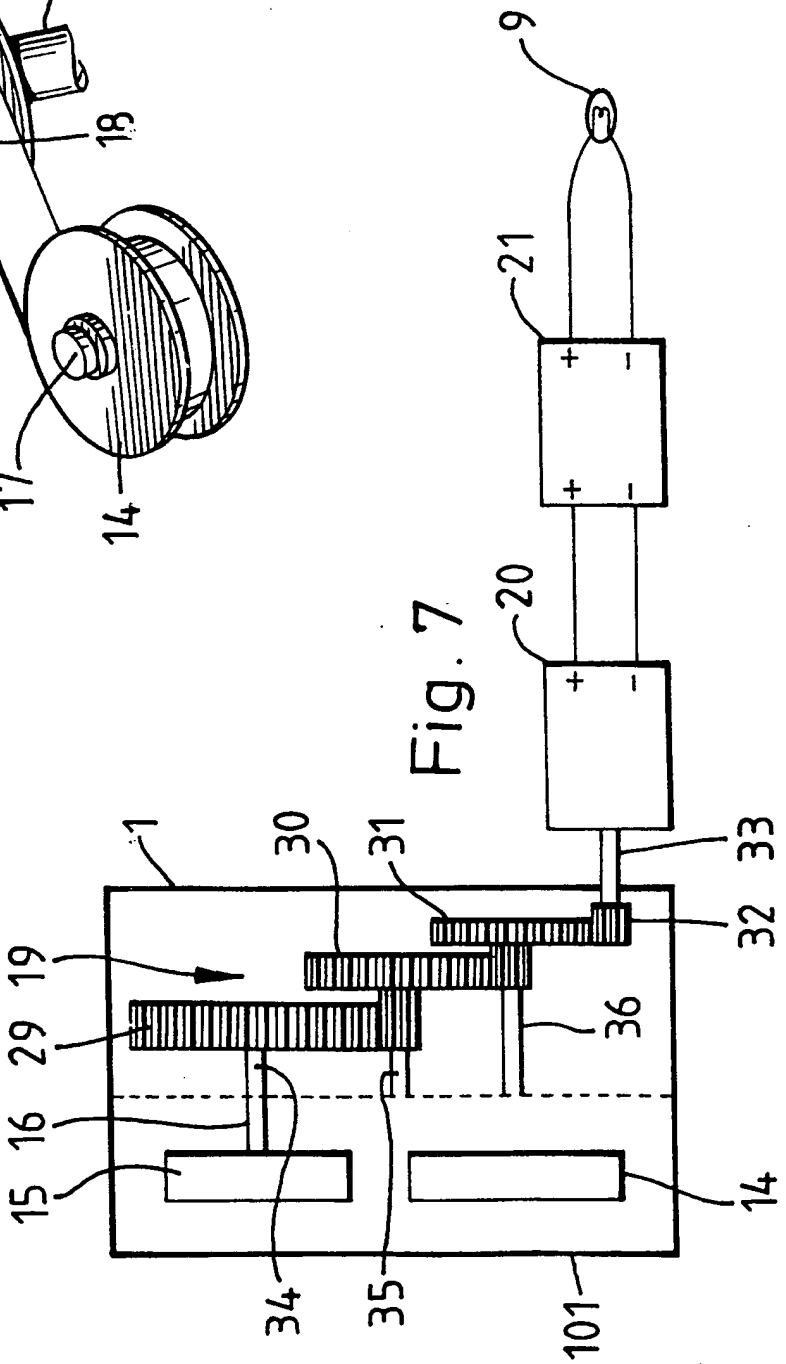


Fig. 7

Fig. 8

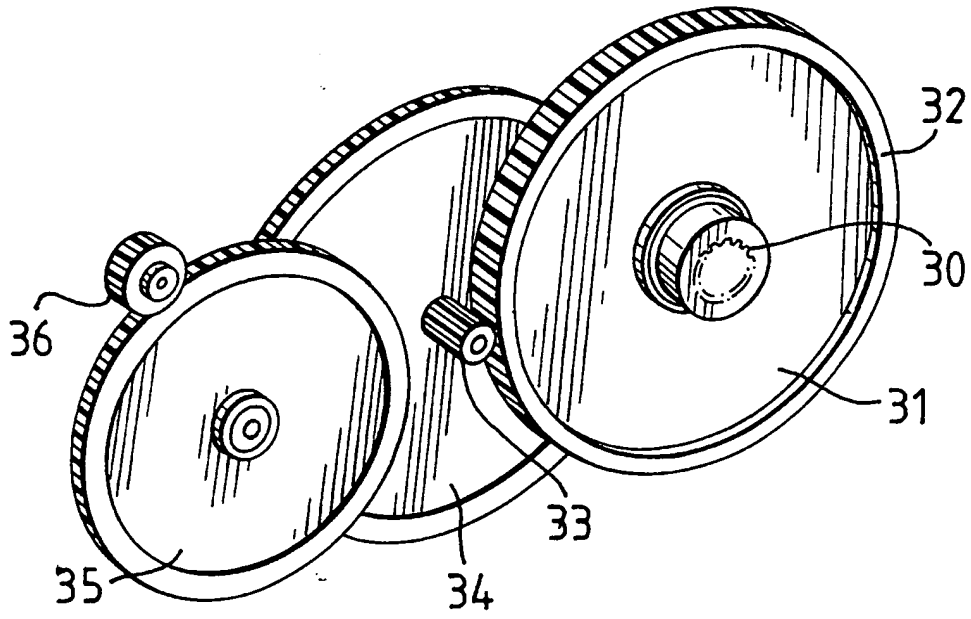
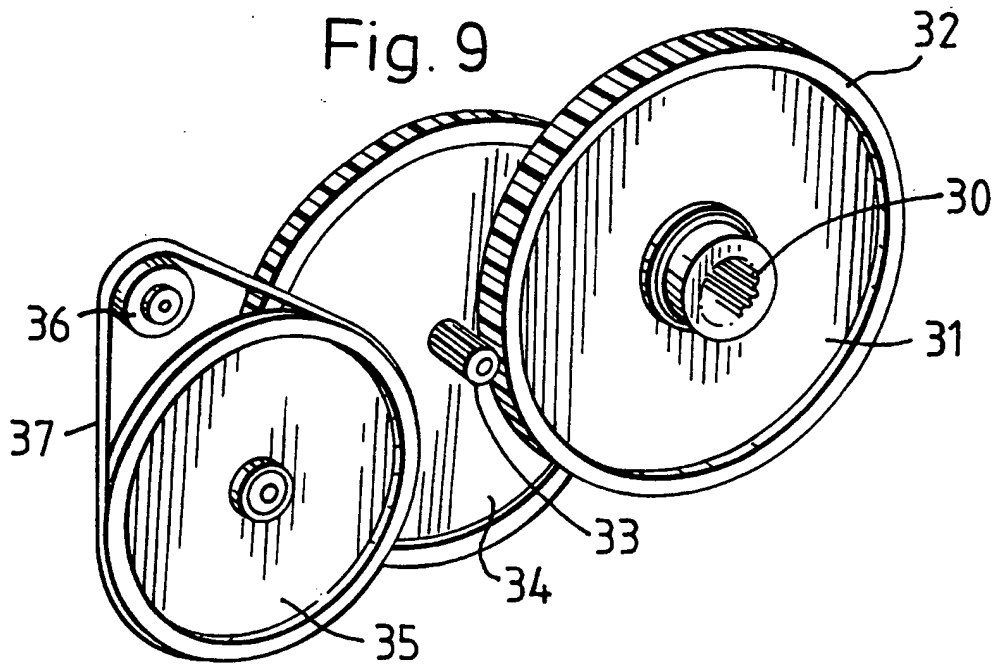


Fig. 9



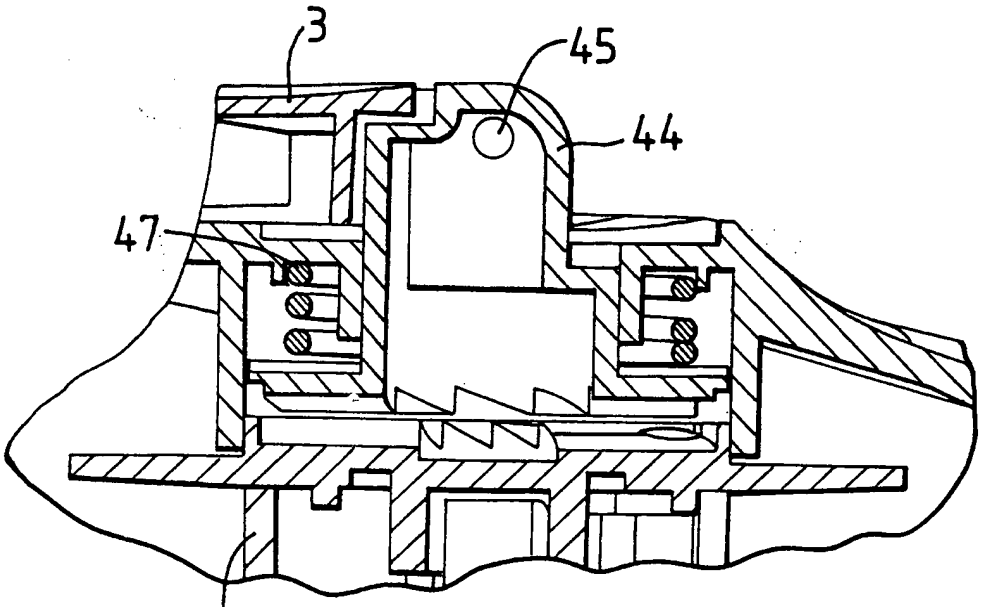


Fig. 10A

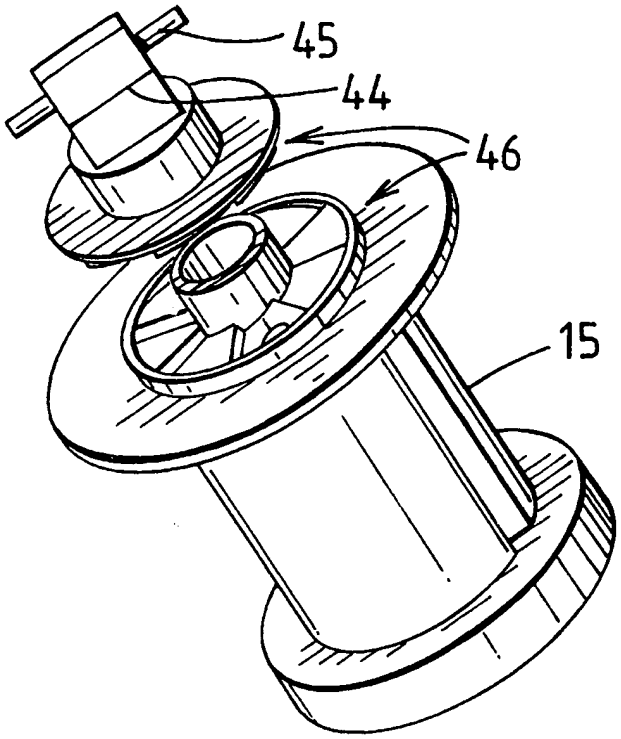


Fig. 10B

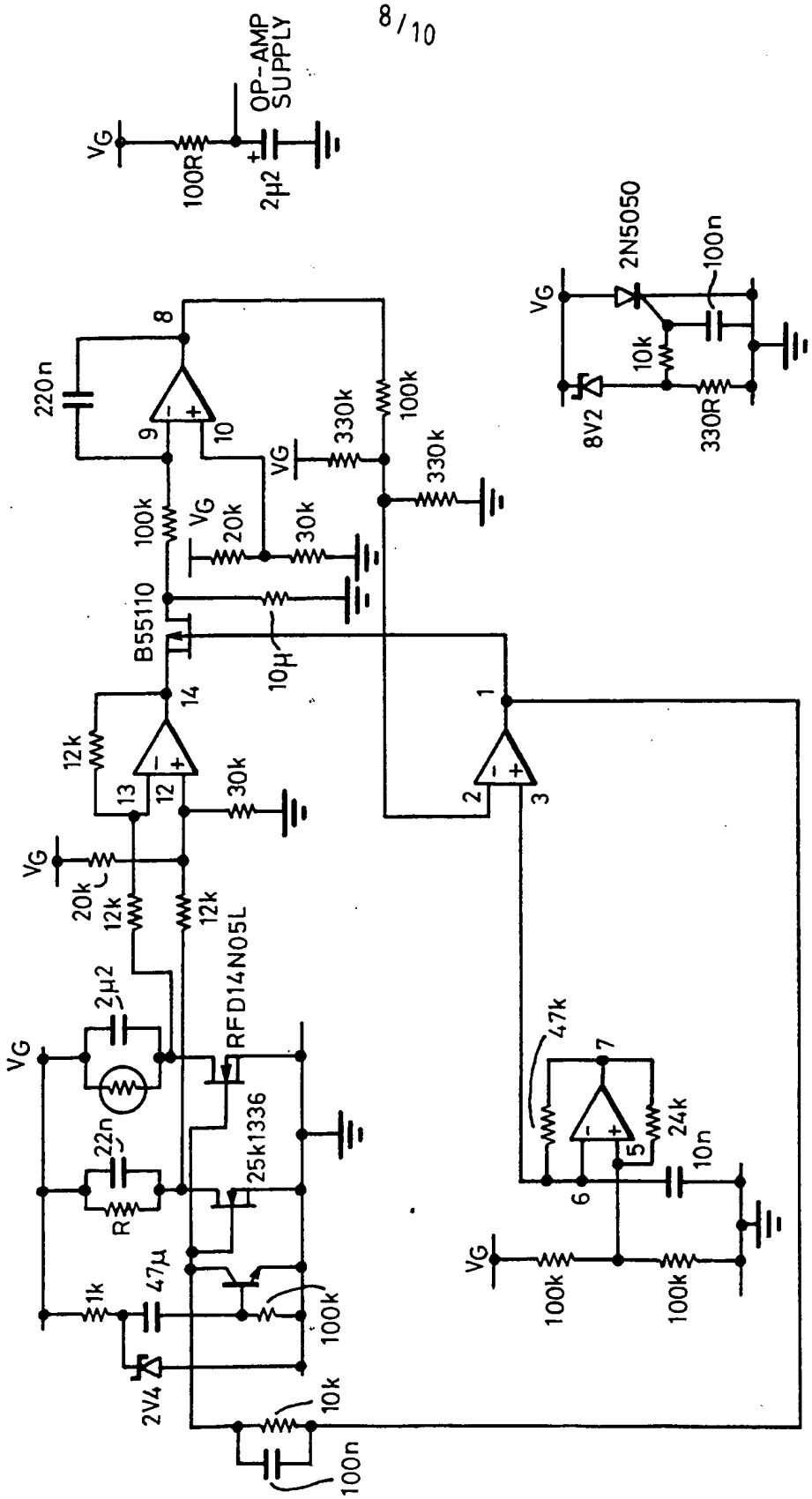

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Fig. 11

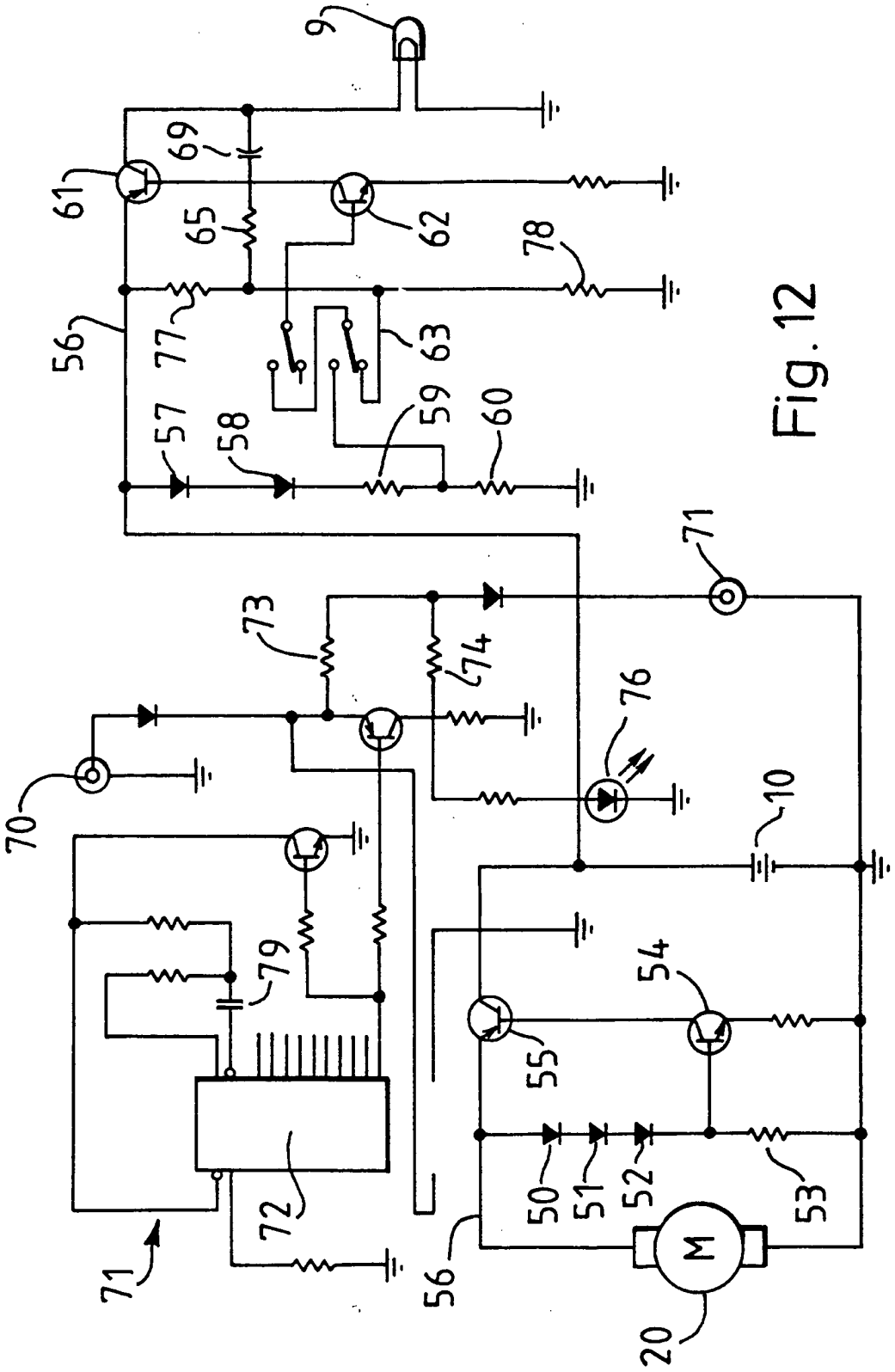
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Fig. 12

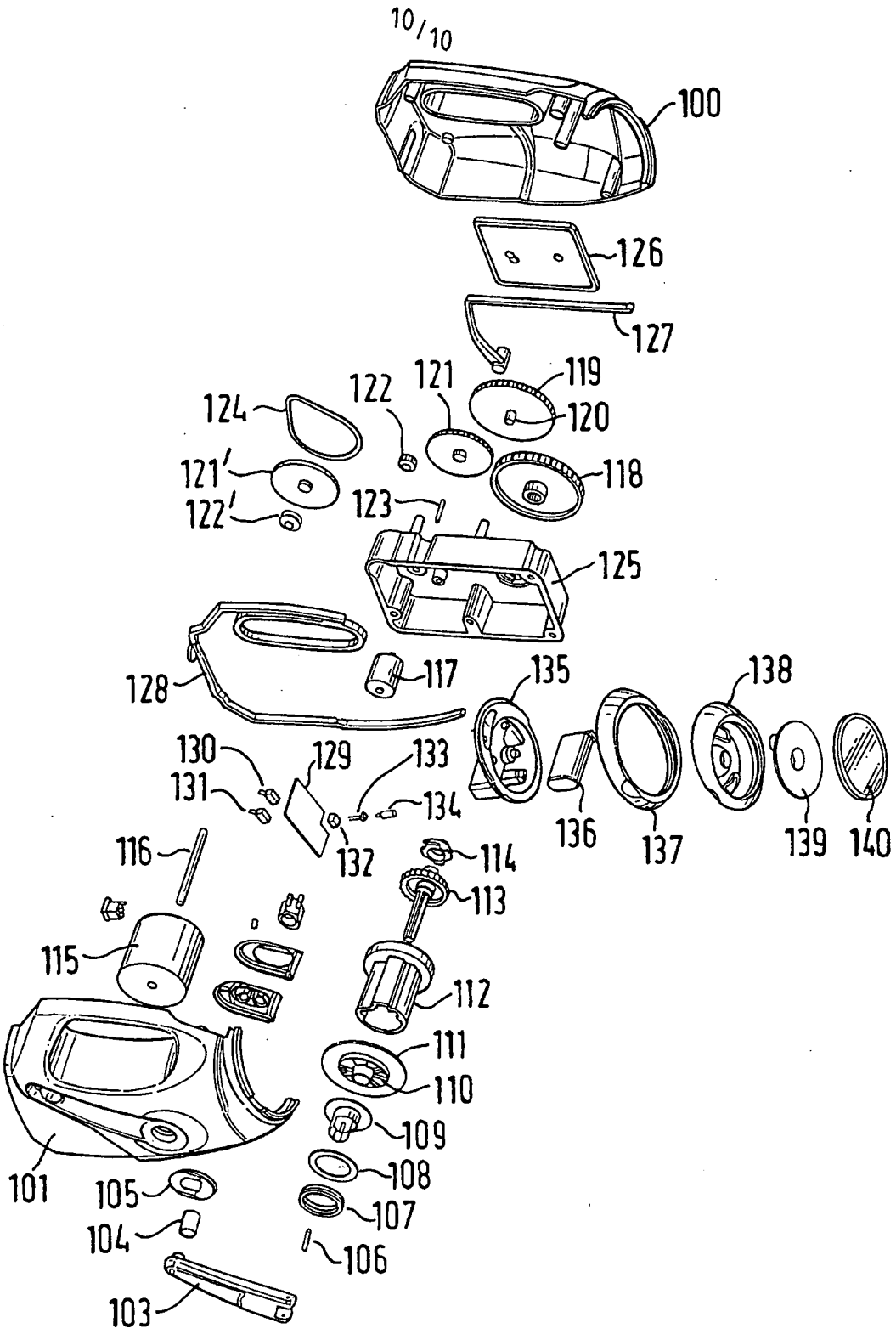
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Fig. 13

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/GB 98/03751

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02K7/18 F21L13/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02K F21L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 630 155 A (KARAKI NOBUO ET AL) 13 May 1997 see column 2, line 64 - column 3, line 4 see column 6, line 50 - column 5, line 60 see figure 3A ---	1-5 6-9,11
X Y	GB 2 304 208 A (BAYLIS GENERATORS LTD) 12 March 1997 see abstract see page 7, line 8 - page 8, line 15 see figures 4,5,9 ---	12 6
Y	US 5 363 445 A (SHYU CHIH-YES) 8 November 1994 see column 3, line 1 - column 3, line 4 --- -/--	7

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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22 April 1999	29/04/1999

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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